Technical Details

- X-ray source: Al Kα (1.48 keV), monochromatic
- spot size: approximately 200 µm diameter
- pressure during analysis: from 10^{-8} mbar to 25 mbar
- temperature during analysis: up to 1000 °C
- single samples up to 40 mm (width) by 40 mm (length) by 40 mm (height) can be inserted
- multiple samples up to 10 mm (width) by 10 mm (length) by 40 mm (height) can be inserted
- air- & moisture-sensitive samples up to 10 mm (width) by 10 mm (length) by 5 mm (height) can be inserted
- three cameras for live sample observation
- inert/reactive agents: N_2, Ar, H_2, O_2, CO, CO_2, H_2O
- fast sample loading procedure
- surface milling using argon ion sputtering allows depth profiling
- inert sample transfer system for air- or moisture-sensitive samples
- semiautomatic system for setting up measurement positions and conditions and task scheduling

Sample environment with 9-position sample holder.
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For Further Information

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Surface Analysis of Materials

X-Ray Photoelectron Spectroscopy (HT-NAP-XPS)

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X-Ray Photoelectron Spectroscopy (HT-NAP-XPS)

The innovative High Temperature Near-Ambient Pressure X-Ray Photoelectron Spectroscopy (HT-NAP-XPS) brings conventional XPS to a new dimension of surface science. Functionalized surfaces can be investigated at pressures up to 25 mbar and temperatures up to 1 000 °C allowing in situ studies of reaction mechanisms and their intermediate stages – especially attractive for materials used in hydrogen technologies.

Our Offer

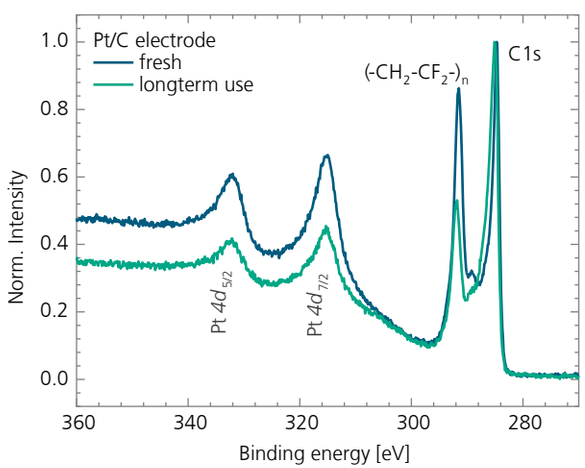
- nondestructive surface analysis with XPS
- performance of measurements on a variety of samples, such as:
  - heterogeneous catalysts (e.g. for fuel cells, water electrolyzers)
  - battery materials
  - photovoltaics
  - microelectronics
  - medical devices
- appropriate handling of air- and moisture-sensitive materials
- variation of test conditions in pressure and temperature (up to 25 mbar and 1 000 °C)
- depth resolution as well as degradation studies
- expertise in data evaluation using CasaXPS
- customized support from sample preparation to transport to measurement conditions, applying lessons learned to improve follow-up experiments

The HT-NAP-XPS system is unique within the Fraunhofer-Gesellschaft and offers a broad spectrum of surface characterization. With this system, chemical states of a broad range of surface types can be investigated either in vacuum or in near-ambient pressure conditions. Our cooperation partners in chemical and automotive industries, process engineering, and surface technologies benefit from XPS investigations under near-ambient pressure conditions to describe the chemical state of material surfaces and track surface changes induced by applying reactive agents.

We analyze changes visible in the photoelectron spectrum and relate them to structural changes and the formation of intermediate species to identify a reaction mechanism. Our scientific focus is the characterization of catalysts and the determination and modification of catalytic mechanisms, e.g. observing material degradation during long-term tests of water electrolysis or fuel cell materials. A variety of other materials typically not eligible for conventional XPS can be investigated using HT-NAP-XPS. Candidates include oxides, ionic liquids, thin films, polymers, powders or biological specimens, for which XPS studies under controlled atmosphere can help infer and explain material properties.

For automated and repeated measurements, the predefinition of measurement positions and conditions for up to nine samples and task scheduling before inserting samples into the EnviroESCA is available. The system is equipped with wide-angle cameras that simplify sample monitoring during measurements. As measurement data comes only from material surfaces, the access to volume information of multilayer samples and interfaces can be achieved via depth-profile analysis using a gas cluster ion beam system. A transfer unit compatible with UHV devices and glovebox systems allows transfer of air- or moisture-sensitive samples.

The HT-NAP-XPS system of Fraunhofer ISE provides high measurement performance for material characterization.



Measured with NAP-XPS: shown are differences in surface concentration of Pt and fluorine-containing species in fresh and aged Pt/C electrodes from water electrolysis cell indicating degradation of ionomer membrane and Pt migration.